

Flight Safety System Challenges

Range Safety is often faced with many challenges when trying to ensure the protection of the public, the local workforce, and property. These challenges must be met with steadfast determination and urgency to ensure that public safety and mission success are preserved. Some of the biggest issues NASA Range Safety dealt with in 2007 are discussed below.

Constellation

NASA Range Safety has been heavily involved in supporting the Constellation program. A major topic of concern in 2007 was ensuring that the Constellation program would meet all applicable range safety requirements. NASA Range Safety met with Constellation program personnel, 45th Space Wing Safety personnel, and pertinent contractors to discuss flight termination system options for the Ares I vehicle shown right and all range safety requirements that the Constellation program must meet.



This group met numerous times to review NPR 8715.5, *Range Safety Program*, and AFSPCMAN 91-710, *Range Safety User Requirements*. NPR 8715.5 is the NASA Range Safety program document while AFSPCMAN 91-710 is the range safety document used by the Eastern Range (45th Space Wing) for new programs. These documents contain range safety user requirements such as airborne flight safety system design, test, and documentation. This group is tailoring these documents to include only the requirements applicable to the Ares I program. This activity is close to completion and it is perceived that this same process will be used for the Ares V vehicle as well. NASA Range Safety will continue to work with this group and others to make sure all applicable range safety requirements are met to help ensure a safe and successful return to the moon and beyond.

Frequency Migration

Many different frequencies are used for flight termination. Each range uses a set of frequencies for flight termination operations. One of the frequencies that has been used for many years at various ranges, including the Eastern and Western ranges, is 416.5 megahertz. However, the National Telecommunications and Information Administration directed the Department of Defense to stop use of 416.5 megahertz for flight termination systems no later than the last day of calendar year 2006. The reason for the change was due to overcrowding in that frequency range and the fact that ultra high frequency wideband systems, such as flight termination systems, are required to operate in the 420-450 megahertz spectrum while 400-420 megahertz is reserved for narrow band systems.

Flight Safety System Challenges

However, range users at the Eastern and Western ranges were not able to meet this mandate so both ranges requested “Exception to Policy” waivers for continued use of 416.5 megahertz. The Eastern Range received approval through 2010 for the fly-out of Shuttle only, while the Western Range received approval through 2008 for Missile Defense Agency launches only. All range users have agreed to migrate to 421 megahertz and have begun to transition. Therefore, the remaining launches scheduled to use 416.5 megahertz have been granted approval.

The Eastern and Western ranges have also used 425 megahertz for quite some time, but due to the interference concern with high-powered radars, it was decided to phase out this frequency to minimize the impact of the radars. Users will be allowed to fly out remaining 425 megahertz receivers through 2008. After this date, they must use 421 megahertz as their flight termination frequency.

Frequency Interference

Some concern still remains over frequency interference between high-powered radars and flight termination system operations at the Eastern and Western ranges. High-powered radars such as the PAVE PAWS radar have shown that they can interfere with flight termination receivers onboard a launch vehicle. These high-powered radars, like the one shown right at Clear Air Force Base in Alaska, operate in the 420-450 megahertz region, the same region that some flight termination receivers operate in. Much research has been done in the last year on these radars and their effect on flight termination receivers. The Eastern and Western ranges have enacted mitigation efforts during range operations to ensure that there is no interference.



Long term solutions, such as moving to a new frequency band or using an autonomous flight safety system, are still being investigated. As long as the radar operators and range personnel agree to the mitigation efforts currently in place, an immediate long term decision is not likely.

Autonomous Flight Safety System

As in previous years, the autonomous flight safety system was a topic of concern for NASA Range Safety in 2007. As the range climate continues to change and evolve, so does the prospect for future technology. Research is being done on autonomous flight safety system now more than ever before to answer key questions about the system. Key concerns that range safety representatives are working include:

- Can this type of system and all relevant components meet applicable range safety requirements?

Flight Safety System Challenges

- What kind of certification program and how much testing will this system need before it is deemed “certified” to fly alone or with command capability?
- Can this type of system be man-rated and used for manned flight?

Whether or not an autonomous flight safety system could be used for a NASA or NASA-sponsored mission remains to be seen, but NASA Range Safety continues to work with other entities to come up with a viable go-forward plan for this technology and to ensure that this type of system will meet all range safety requirements and not add increased risk during range operations.

Enhanced Flight Termination System

NASA Range Safety has been involved in the enhanced flight termination system program for many years now. NASA Range Safety supported numerous meetings and teleconferences pertaining to the design, testing, and implementation of this system. Although there were several technical issues and problems that arose, 2007 was a year of milestones and accomplishment.

In 2007, the enhanced flight termination system program completed qualification testing on the first set of receivers and also completed the first end-to-end demonstration of the system. The system performed successfully and all goals of the mission were satisfied. NASA Range Safety representation was present during this mission in order to gain a better understanding of enhanced flight termination system operations. With this successful mission, the enhanced flight termination system is on its way to becoming a legitimate, certified system. NASA Range Safety continues to be a part of the enhanced flight termination system program and provides technical support when needed.

Secure Flight Termination System

Presently, two different types of flight termination systems are in use: non-secure and secure. The secure system is known as High Alphabet and is used on most launch vehicles operating at the Eastern and Western ranges. However, after 2014 High Alphabet will no longer be available for use.

The National Security Agency will de-certify High Alphabet as a secure system effective 1 January 2015. The agency no longer views High Alphabet as a robust system viable for space launch applications and range operations. If a secure system is to be used for a mission, NASA and the Department of Defense are both bound by requirements that state a secure system must use National Security Agency-approved cryptography. Being that High Alphabet will no longer be National Security Agency approved, ranges and range users must transition to an alternative.

Right now the only viable option is the enhanced flight termination system, a National Security Agency-approved, encrypted system. However, this system is very new and has little experience. To migrate to this new system, both ranges and range users must upgrade their equipment to support the enhanced flight termination system.

Flight Safety System Challenges

The colored boxes shown below in the diagram of the enhanced flight termination system vehicle and ground systems are components that the ranges and range users must upgrade to support the enhanced flight termination system. NASA Range Safety will continue to work with range users and range personnel to make this transition as easy as possible.

